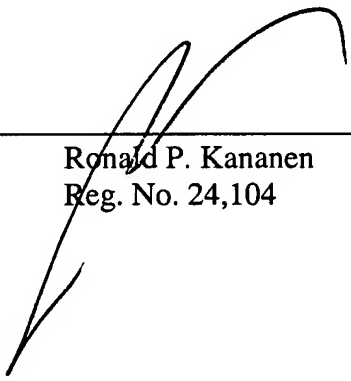# REMARKS

This Preliminary Amendment is requested prior to the initial examination of the above-identified patent application to address minor matters of form and syntax. No new matter has been added. If the Examiner has any suggestions for placing this application in even better form, the Examiner is invited to telephone the undersigned at the number listed below.

Respectfully submitted,

Date:

Ronald P. Kananen
Reg. No. 24,104

RADER, FISHMAN & GRAUER, PLLC
Lion Building
1233 20th Street, N.W.
Washington, D.C. 20036
Telephone No.: (202) 955-3750
Facsimile No.: (202) 955-3751
Customer No. 23353

DC197704

4

RECORDING DEVICE AND METHOD, RECORDING MEDIUM AND PROGRAM

CROSS REFERENCES TO RELATED APPLICATIONS

[0001]

5   The present document is based on Japanese Priority Document JP 2003-101583, filed in the Japanese Patent Office on April 4, 2004, the entire contents of which being incorporated herein by reference.

10   BACKGROUND OF THE INVENTION

[0002]

1. Field of the Invention

[0003]

      The present invention relates to recording device and
15   method, a recording medium and a program, for example, which are suitable for use to record first data at a high bit rate and second data at a lower bit rate than that of the first data, both data corresponding to the same material, on an information recording medium.

20   [0004]

2. Description of Related Art

[0005]

      In recent years, information recording mediums media, such as optical discs, at with a remarkably improved
25   recording rate have been put into practical use. On such information recording media, relatively high-quality video data can be recorded for long time.

[0006]

      The applicant of the present invention has already

1

proposed a method of recording high-resolution video data
and low-resolution video data for the same image contents
on an optical disc so as to use the low-resolution video
data for editing and the like (for example, see Patent

5   Document 1 cited below).

[0007]

[Patent Document 1]

Japanese Patent Application Publication Hei JP 11-136631

[0008]

10   In the proposed method mentioned above, the high-
resolution video data and the low-resolution video data are
recorded on the optical disc. However, there is no
proposal yet to read out the recorded high-resolution video
data or low-resolution video data so as to use the read out

15   data for any process while the recording is in progress.

SUMMARY OF THE INVENTION

[0009]

In view of the above-described background, the present

20   invention is devised to substantially simultaneously record
high bit-rate data and low bit-rate data for the same
material in time division while reading out the recorded
low bit-rate data simultaneously with the recording so as
to use the read out data for a verification process or

25   time-shift playback.

[0010]

A recording medium according to the present invention
includes: first generation means for encoding input
material data so as to generate first encoded data; second

generation means for encoding the input material data so as to generate second encoded data; recording means for recording the first encoded data generated by the first generation means and the second encoded data generated by

5   the second generation means on an information recording medium in an alternate manner in terms of time; and readout means for reading out the second encoded data recorded on the information recording medium while the recording means is recording any one of the first and second encoded data.

10 [0011]

The recording device according to the present invention further includes: storage means for storing the second encoded data recorded on the information recording medium by the recording means; and comparison means for

15 comparing the second encoded means read out by the readout means with the stored second encoded data.

[0012]

The recording means can rewrite the encoded data stored by the storage means on the information recording

20 medium in accordance with the result of comparison by the comparison means.

[0013]

The recording means can rewrite the encoded data stored by the storage means in a separate unrecorded area

25 on the information recording medium if a plurality of successive results of the comparison by the comparison means shows that the data are not identical.

[0014]

The recording means can perform recording on the

information recording medium by a CLV method.

[0015]

The recording device according to the present invention can further include reproducing means for

5   decoding and reproducing the second encoded data read out by the readout means.

[0016]

A recording method according to the present invention includes: a first generation step of encoding input

10 material data so as to generate first encoded data; a second generation step of encoding the input material data so as to generate second encoded data; a recording step of recording the first encoded data generated in the first generation step and the second encoded data generated in ~~at~~

15 the second generation step on an information recording medium in an alternate manner in terms of time; and a readout step of reading out the second encoded data recorded on the information recording medium while any one of the first and second encoded data is being recorded in

20 the recording step.

[0017]

A program of a recording medium according to the present invention includes: a first generation step of encoding input material data so as to generate first

25 encoded data; a second generation step of encoding the input material data so as to generate second encoded data; a recording step of recording said first encoded data generated in the first generation step and the second encoded data generated in the second generation step on the

information recording medium in an alternate manner in terms of time; and a readout step of reading out the second encoded data recorded on the information recording medium while any one of the first and second encoded data is being

5 recorded in the recording step.

[0018]

A program according to the present invention makes a computer execute a process including: a first generation step of encoding input material data so as to generate

10 first encoded data; a second generation step of encoding the input material data so as to generate second encoded data; a recording step of recording the first encoded data generated in the first generation step and the second encoded data generated in the second generation step on an

15 information recording medium in an alternate manner in terms of time; and a readout step of reading out the second encoded data recorded on the information recording medium while any one of the first and second encoded data is being recorded in the recording step.

20 [0019]

In the recording device and method, and the program according to the present invention, input material data is encoded to generate first encoded data and second encoded data. The first encoded data and the second encoded data

25 are alternately recorded on an information recording medium in terms of time. Furthermore, the second encoded data recorded on the information recording medium is read out while the first and second encoded data are being recorded.

[0020]

As described above, according to the present invention, high bit-rate data and low bit-rate data for the same material are substantially simultaneously recorded in time division. Simultaneously with the recording, the recorded

5   low bit-rate data is read out so as to be used for verification or time-shift playback during the recording.
[0021]

Moreover, once the low resolution data is recorded, the concealment is made possible. Furthermore, the

10   reliability of time code and meta data is improved to lower the possibility that the main track data is recorded in a defective area of the information recording medium. Since the amount of low resolution data is smaller than that of the main track data, the low resolution data can be read

15   out even if excessive time generated in the recording is short and even by a CLV method whose readout speed is lowered. Therefore, contents of the recorded part can be audio-visually confirmed as motion pictures while the recording is in progress. Moreover, the data of the

20   recorded part is externally transmitted while the recording is in progress so that the transmitted data is used for proxy-edit. Furthermore, since it is not necessary to increase the number of revolutions of the optical disc for readout, the present invention is also advantageous in that

25   any uncomfortable noises are not generated. Since data, which has been just recorded, and data read out later are arranged on the same memory space, both data can be treated in a similar manner, thereby simplifying a circuit. Even the low resolution data has a transmission speed lower than

single speed in many cases. Therefore, if the transmission can be started simultaneously with the start of recording as in this embodiment, a~the total amount of time required for transmission of the low resolution data can be reduced.

5

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

The above and other objects, features and advantages of the present invention will become more apparent from the

10   following description of the presently preferred exemplary embodiments of the invention taken in conjunction with the accompanying drawings, in which:

[0023]

Fig. 1 is a block diagram showing an exemplary

15   configuration of a disc recording/reproducing device with the application of the present invention;

[0024]

Fig. 2 is a diagram showing an example of a recording format of an optical disc;

20   [0025]

Fig. 3 is a block diagram showing an exemplary configuration of a PCI interface for a verification process;

[0026]

25   Fig. 4 is a flowchart for illustrating the verification process;

[0027]

Fig. 5 is a diagram showing an example of the verification process in a case where a~the recording rate

of a disc drive is single speed;

[0028]

Fig. 6 is a diagram showing an example of the verification process in a case where a—the recording rate

5   of the disc drive is double speed;

[0029]

Fig. 7 is a diagram showing an example of time-shift playback in a case where a—the recording rate of the disc drive is single speed;

10   [0030]

Fig. 8 is a diagram showing an example of time-shift playback in a case where a—the recording rate of the disc drive is double speed;

[0031]

15   Fig. 9 is a block diagram showing an exemplary configuration of a PCI interface for an upload process;

[0032]

Fig. 10 is a diagram showing an example of the upload process;

20   [0033]

Fig. 11 is a flowchart for illustrating a writing process for realizing the upload process in combination with a transmission process;

[0034]

25   Fig. 12 is a flowchart for illustrating a data storage process at a step S14 in Fig. 11;

[0035]

Fig. 13 is a flowchart for illustrating a data readout process at a step S17 in Fig. 11;

[0036]

Fig. 14 is a flowchart for illustrating the transmission process for realizing the upload process in combination with the writing process;

5 [0037]

Fig. 15 is a diagram for illustrating set values of frequency limit and exhaustion limit in the upload process;

[0038]

Fig. 16 is a diagram for schematically illustrating

10 high-speed playback by a conventional DVD player or the like;

[0039]

Fig. 17 is a diagram for schematically illustrating high-speed playback by the disc recording/reproducing

15 device according to the embodiment of the present invention;

[0040]

Fig. 18 is a diagram for schematically illustrating a process at the transition from high-speed playback to

20 normal-speed playback;

[0041]

Fig. 19 is a diagram for schematically illustrating a horizontal division of a screen in high-speed playback;

[0042]

25 Fig. 20 is a diagram showing an example of adjustment of the division of the screen when the reproduction speed reaches a target reproduction speed in high-speed playback;

[0043]

Fig. 21 is a diagram showing an example of adjustment

of the division of the screen when a reproduction mode
returns from high-speed playback to normal-speed playback;
and

[0044]

5   Fig. 22 is a flowchart for illustrating a high-speed
playback process.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0045]

10   Hereinafter, a preferred embodiment of the present
invention will be described. In order to clarify the
correlation between each means of the invention recited in
the appended claims and the following embodiment, the
features of the present invention will be described below
15   in such a manner that each means is followed by a
corresponding embodiment in parentheses (only one example
for each means).

[0046]

       More specifically, a recording device according to
20   the present invention (for example, a disc
recording/reproducing device shown in Fig. 1) includes:
first generation means (for example, a main encoder 15 in
Fig. 1) for encoding input material data so as to generate
first encoded data (for example, main track data); second
25   generation means (for example, a low resolution encoder 17
shown in Fig. 1) for encoding the input material data so as
to generate second encoded data (for example, low
resolution data); recording means (for example, a process
at a step S1 shown in Fig. 4 executed by a disc drive 2 in

Fig. 1) for recording the first encoded data generated by the first generation means and the second encoded data generated by the second generation means on an information recording medium in an alternate manner in terms of time;

5 and readout means (for example, a process at a step S3 shown in Fig. 4 executed by the disc drive 2 shown in Fig. 1) for reading out the second encoded data recorded on the information recording medium while the recording means is recording any one of the first and second encoded data.

10 [0047]

The recording device according to the present invention further includes: storage means (for example, a buffer 31 in Fig. 3) for storing the second encoded data recorded on the information recording medium by the

15 recording means; and comparison means (for example, a comparison section 32 in Fig. 3) for comparing the second encoded means read out by the readout means with the stored second encoded data.

[0048]

20 The recording device according to the present invention can further include reproducing means (for example, a low resolution decoder 5 in Fig. 1) for playing back the second encoded data read out by the readout means.

[0049]

25 Fig. 1 shows an exemplary configuration of a disc recording/reproducing device according to an embodiment to which the present invention is applied. The disc recording/reproducing device encodes an input video signal at two image qualities, that is, at a high or standard

resolution and a lower resolution, by a predetermined

encoding method. The resulting high bit-rate encoded data

(at a high resolution or a standard resolution) and low

bit-rate encoded data (at a low resolution) are

5   recorded/played back on/from an optical disc 1.

[0050]

The high bit-rate encoded data is decoded so as to be

provided for a user in normal playback (normal

reproduction). Hereinafter, the high bit-rate encoded data

10 is also referred to as main track data. On the other hand,

the low bit-rate encoded data is decoded so as to be

provided for a user in, for example, high-speed playback

(reproduction) or editing. Hereinafter, the low bit-rate

encoded data is also referred to as low resolution data.

15 [0051]

The optical disc 1 can be inserted into and removed

from the disc drive 2. In accordance with control by a

drive control section 14 of the system controller 10, the

disc drive 2 records the main track data or the low

20 resolution data supplied from a PCI (Peripheral Component

Interconnect) interface 3 on the optical disc 1 inserted to

the disc drive 2 with a built-in pickup 2A. The disc drive

2 also reads out the main track data or the low resolution

data recorded on the optical disc 1 with the pickup 2A so

25 as to supply it to the PCI interface 3.

[0052]

The PCI interface 3 includes a buffer 31 (Fig. 3)

therein, and acts as an interface between the disc drive 2

and one of a main decoder 4, a low resolution decoder 5, a

12

main encoder 15 and a low resolution encoder 17.

[0053]

For example, the PCI interface 3 supplies the main
track data supplied from the disc drive 2 to the main

5   decoder 4 while supplying the low resolution data similarly
supplied from the disc drive 2 to the low resolution
decoder 5. The PCI interface 3 also supplies the low
resolution data supplied from the disc drive 2 to a
transmission section 18.

10   [0054]

The PCI interface 3 also acts as an interface between
the disc drive 2 and the main encoder 15 or the low
resolution encoder 17 so as to supply the main track data
supplied from the main encoder 15 to the disc drive 2 while

15   supplying the low resolution data supplied from the low
resolution encoder 17 to the disc drive 2.

[0055]

In this embodiment, a play list produced by non-
destructive editing or the like can also be recorded on the

20   optical disc 1. If the play list is recorded on the
optical disc 1, the play list is read out from the optical
disc 1 by the disc drive 2. Then, the readout play list is
supplied to a controller 11 through the PCI interface 3.
Furthermore, as described below, meta data or a time code

25   is also recorded on the optical disc 1. The meta data or
the time code is read out from the optical disc 1 by the
disc drive 2 so as to be supplied to the controller 11
through the PCI interface 3.

[0056]

SON-2966
REDLINE VERSION

Application No.: 10/813,174

        The main decoder 4 includes a buffer 4A in which the
main track data supplied from the PCI interface 3 is
temporarily stored. The main decoder 4 performs, for
example, MPEG-decoding on the main track data stored in the
5   buffer 4A in accordance with the control of a main decoder
control section 13 of the system controller 10. Then, the
main decoder 4 supplies the resulting high-resolution or
standard-resolution video data (hereinafter, also referred
to as main track video data) to a switch 7. The main
10   decoder 4 also supplies a ready flag, which indicates a
ready state of an output of video data obtained by decoding
the main track data supplied from the PCI interface 3, to
the switch 7 and the main decoder control section 13.
[0057]

15   In this case, the ready flag is, for example, a 1-bit
flag. If the output of video data by the main decoder 4 is
ready, a—the value of the ready flag is set to, for example,
1. If not, a—the value of the ready flag is set to, for
example, 0.
20   [0058]

        The ready flag indicates an output preparation state
of the main track data in a broad manner. Therefore, it is
apparent that a state where the main decoder 3 is decoding
a picture instead of decoding another picture that should
25   be decoded is included in the output preparation state. In
addition, a state where an error occurs in the main track
data to prevent a picture from being decoded is also
included in the output preparation state.
[0059]

The low resolution decoder 5 includes a buffer 5A in
which the low resolution data supplied from the PCI
interface 3 is temporarily stored. Then, the low
resolution decoder 5 decodes the low resolution data stored

5 in the buffer 5A by a predetermined method in accordance
with the control of a low resolution decoder control
section 12 of the system controller 10. Then, the low
resolution decoder 5 supplies the resulting video data at a
low resolution (hereinafter, also referred to as low

10 resolution video data) to a resize section 6.
[0060]

    The resize section 6 is configured with poly-phase
filters at, for example, 5:2 (3:1 in a case of PAL (Phase
Alternation by Line) by 11:4. The resize section 6 thins

15 out horizontal lines of the low resolution data
corresponding to progressive video data, in which one frame
is composed of 30 horizontal lines, so as to generate
interleaved video data, in which one frame is composed of
60 horizontal lines. Furthermore, the resize section 6

20 interpolates pixels of the video data and the like so as to
generate video data having the same size (the same number
of pixels) as that of the main track video data output from
the main decoder 4 (hereinafter, also referred to as
resized video data). Then, the resize section 6 supplies

25 the thus generated video data to the switch 7.
[0061]

    The switch 7 selects one of the main track video data
output from the main decoder 4 and the resized video data
output from the resize section 6 in accordance with the

15

ready flag supplied from the main decoder 4 so as to output

the selected one to the OSD (On Screen Display) section 8.

The switch 7 also selects one of the main track video data

output from the main decoder 4 and the resized video data

5   output from the resize section 6 in accordance with the

control from the controller 11 so as to supply the selected

one to the OSD section 8. Therefore, in the embodiment

shown in Fig. 1, the selection ~~for~~ of one of the main track

video data and the resized video data to be output by the

10   switch 7 can be made not only by the ready flag but also by

the control from the controller 11.

[0062]

The OSD section 8 superimposes information such as a

time code on the video data supplied from the switch 7 as

15   needed so as to supply it to a scan converter 9. The scan

converter 9 converts a scanning method of the video data

supplied from the OSD section 8 as needed so as to supply

it to a display 22. The OSD section 8 includes a buffer

for storing the video data supplied from the switch 7. In

20   high-speed playback, the OSD section 8 combines a plurality

of video data obtained by decoding the low resolution data

supplied from the switch 7 in accordance with the control

from the system controller 10 so as to output the combined

video data to a later stage. A process in the high-speed

25   playback will be described below with reference to Fig. 16

and the subsequent drawings.

[0063]

The controller 11; the low resolution control section

12; the main decoder control section 13; and a drive

16

control section 14 constitute the system controller 10. The system controller 10 controls each of the blocks constituting the device.

[0064]

5   More specifically, the controller 11 receives an operating signal supplied by manipulation of a remote commander (or a remote controller) 21 by a user, and the play list, the time code or the meta data supplied from the PCI interface 3 so as to control the switch 7 or the low

10 resolution decoder control section 12 in accordance with the operation signal, the play list, the time code, the meta data or the like.

[0065]

       The low resolution decoder control section 12 controls

15 the low resolution decoder 5 and the drive control section 14 in accordance with the control from the controller 11.

[0066]

       The main decoder control section 13 monitors the control on the low resolution decoder 5 by the low

20 resolution decoder control section 12 and controls the main decoder 4 and the drive control section 14 so as to follow the control.

[0067]

       The drive control section 14 is configured with, for

25 example, a file system and a device driver. The drive control section 14 controls the disc drive 2 in accordance with the control from the low resolution decoder control section 12 and the main decoder control section 13.

[0068]

17

The main encoder 15 encodes video data, which is input
so as to be recorded, at a predetermined high bit rate by
an MPEG-encoding method or the like. Then, the main
encoder 15 outputs the resulting main track data to the PCI
5   interface 3. A resize section 16 performs a reverse
process to that performed by the resize section 6 on the
video data which is input so as to be recorded. The resize
section 16 outputs the resulting progressive video data, in
which one frame is composed of 30 horizontal lines, to the
10   low resolution encoder 17. The low resolution encoder 17
encodes the video data input from the resize section 16 by
a JPEG (Joint Photographic Coding Experts Group) encoding
method or the like at a predetermined bit rate lower than
the bit rate of encoding by the main encoder 15. Then, the
15   low resolution encoder 17 outputs the resulting low
resolution data to the PCI interface 3.
[0069]

The remote commander 21 outputs, for example, an
infrared ray operating signal in accordance with ~~the~~ a
20   manipulation by a user. The display 22 displays the video
data supplied from the scan converter 9.
[0070]

In the embodiment shown in Fig. 1, for example, the
system controller 10 can be configured with a software,
25   whereas the blocks other than the system controller 10 can
be configured with dedicated hardwares, respectively.
Moreover, for example, the main decoder 4, the low
resolution decoder 5, the resize section 6, the switch 7,
the main encoder 15, the resize section 16, the low

resolution encoder 17 and the like can be configured by making a DSP (Digital Signal Processor) or the like execute a program. Furthermore, the system controller 10 may be configured with a dedicated hardware instead of a software.

5   [0071]

In the disc recording/reproducing device shown in Fig. 1, the recording or reproducing is performed on the optical disc 1. However, information recording mediums media other than the optical disc, for example, a magnetic disk, a

10 magneto-optical disc or a magnetic tape may also be used for recording or reproducing of data.

[0072]

Next, Fig. 2 shows a recording format of the optical disc 1.

15 [0073]

The optical disc 1 is, for example, a CLV (Constant Linear Velocity) system optical disc. A track of the optical disc 1 is divided into a plurality of sectors. Furthermore, a cluster corresponding to a unit of

20 reading/writing data from/on the optical disc 1 is composed of at least one sector. In this case, the cluster can be composed of, for example, a 64-kilobyte recording area or the like.

[0074]

25 As described above, the main track data and the low resolution data corresponding to the main track data are recorded on the optical disc 1. The main track data and the low resolution data are intermittently recorded in units of a predetermined amount of time, for example, 1.5

to 2 seconds, of the original video data (video data before being encoded) or in units of a predetermined amount of the original data.

[0075]

5   More specifically, assuming that a predetermined unit containing the main track data and the low resolution data for a predetermined period of time of the original video data or a predetermined amount of the original video data is referred to as a carton, the main track data and the low

10   resolution data are recorded for each carton on the optical disc 1 as shown in Fig. 2. In consideration of data recording on the CLV system optical disc 1, high-speed playback (so-called shuttle playback), data concealment, eject time of the optical disc 1 and the like, it is

15   suitable that the main track data to be contained in each carton corresponds to, for example, 1.5 to 2 seconds of the original video data, as described above.

[0076]

The carton is composed of, for example, as shown in

20   Fig. 2, the low resolution data and the main track data, which are consecutively arranged. Therefore, the contents of the low resolution video data obtained by decoding the low resolution data arranged in a carton are the same as those of the main track video data obtained by decoding the

25   main track data in the same carton except for their resolutions.

[0077]

Besides the video data, the main track data can contain audio data associated with the video data. If the

main track data contains both the video data and the audio

data, for example, as shown in Fig. 2, the video data for a

predetermined amount of data or a predetermined period of

reproduction time and the audio data associated with the

5   video data are arranged in combination.

[0078]

    As the video data contained in the main track data in

this case, for example, video data at a bit rate of 25 Mbps

(Mega bits per second), in which one GOP (Group of

10   Pictures) is formed by 15 frames, can be used. As the

audio data contained in the main track data in this case,

for example, 4-channel audio data at a total bit rate of 3

Mbps, which is 16-bit quantized at a sampling rate of 48

kHz, can be used. Furthermore, as the low resolution data,

15   for example, data obtained by JPEG-encoding video data of

256 by 192 pixels can be used.

[0079]

    If the low resolution data is obtained by JPEG-

encoding video data as described above, the low resolution

20   decoder 5 shown in Fig. 1 is configured with a JPEG decoder

for JPEG decoding.

[0080]

    In addition to the low resolution data and the main

track data, the time code of the video data, which is

25   obtained by decoding the low resolution data and the main

track data, and the meta data in which predetermined

information is arranged, and the like can be contained in

the carton. In the meta data, it is possible to provide

not only arbitrary information for a user but also a

recording start position of the main track data in the carton and the information for the structure of GOP of the video data contained in the main track data. In the example shown in Fig. 2, the time code and the meta data

5   are arranged together with the low resolution data. More specifically, assuming that a combination of the low resolution data, the time code and the meta data is referred to as a tag, the tag is situated at the head of the carton (the position on the optical disc 1, which is

10   first read out) followed by the main track data. Therefore, in a case where the carton recorded on the optical disc 1 is to be read out, the tag is first read out followed by the main track data.

[0081]

15   Assuming that a—the total bit rate of the meta data such as the time code as described above and the low resolution data is 2 Mbps, a—the bit rate of the data recorded on the optical disc 1 in units of carton shown in Fig. 2 is 30 (= 25 + 3 + 2) Mbps. Therefore, an optical

20   disc having a recording rate of, for example, 35 Mbps or the like, which recording rate satisfactorily falls within the range of practical use, can be used as the optical disc 1. It is apparent that the disc drive 2 has a performance of recording data at a recording rate of 35 Mbps or higher.

25   [0082]

The low resolution data is arranged at a position on the optical disc 1 separately from corresponding main track data. In addition, the low resolution data has a sufficiently low bit rate and a small amount of data as

compared with the main track data. Therefore, since the
low resolution data can be verified (verified if it is
correctly recorded or not) when it is recorded on the
optical disc 1, the low resolution data can be recorded
5   with high reliability as compared with the main track data.
The verification of the low resolution data will be
described below with reference to Figs. 3 to 6.
[0083]

     If the low resolution data is recorded, for example,
10 after the video data is encoded by a fixed encoding method
such as JPEG as described above, the contents recorded on
the optical disc 1 can be easily confirmed regardless of
the encoding method employed for the main track data. More
specifically, in this case, a device capable of performing
15 at least JPEG decoding can decode the low resolution data
even if it cannot decode the main track data. Accordingly,
the contents recorded on the optical disc 1 can be
confirmed.
[0084]

20   As described above, since not only the main track data
but also the low resolution data corresponding to the video
data of the main track data but having a smaller amount of
data are recorded on the optical disc 1, the low resolution
data can be read out together with the main track data from
25 the optical disc 1. Therefore, for example, if an error
occurs in the main track data, error concealment can be
performed by using the low resolution data so as to prevent
real time playback (real time reproduction) from being
interrupted. Moreover, in a case where only the main track

data is read out from the optical disc 1, the low

resolution data having a smaller amount of data is

immediately read out so as to be played back even if, for

example, the main track data fails to be read out to be too

5   late for real time playback. As a result, <u>an interruption

in</u> the real time playback can be prevented from being

interrupted.

[0085]

Furthermore, for example, in a case where high-speed

10 playback (so-called shuttle playback) whose reproduction

speed is higher than a normal reproduction speed is

performed, the low resolution data which can be

advantageously decoded within a shorter period of time is

used instead of the main track data that requires longer

15 time for decoding. As a result, the number of images,

which can be displayed in the high-speed playback, that is,

the amount of information provided for a user can be

increased.

[0086]

20 As described above, the main track data may contain

the audio data in addition to the video data in some cases.

In this embodiment, however, the description of a process

of the audio data is herein omitted for simplification of

the description. Although a pattern is described as

25 containing the entire main track data in the carton, an

actual pattern has a fluctuation; for example, the main

track video data corresponding to the low resolution data

is sometimes recorded in the precedent or subsequent carton.

Moreover, in the recording pattern on the actual disc, the

data are not arranged with regularity as shown in Fig. 2 in some cases due to redundant data for demodulation or for error correction or for convenience of cluster control.
[0087]

5   Next, the verification of the low resolution data, that is, the process for verifying if the low resolution data is correctly recorded in recording or not (hereinafter, also referred to as a verification process) will be described with reference to Figs. 3 to 6.

10   [0088]

      Fig. 3 shows an exemplary inner configuration of the PCI interface 3 for the verification process. The buffer 31 temporarily stores the low resolution data input from the low resolution encoder 17, which is to be recorded on

15   the optical disc 1. A comparison section 32 compares the low resolution data stored in the buffer 31 and the low resolution data recorded on the optical disc by the disc drive 2 so as to be immediately read out from the optical disc 1 by the disc drive 2 with each other to determine if

20   they are identical with each other. If it is determined that these data are not identical with each other as a result of the comparison, the low resolution data stored in the buffer 31 is recorded on the optical disc 1 again.
[0089]

25   A procedure of the verification process is described with reference to a flowchart shown in Fig. 4. The verification process is executed each time the low resolution data is recorded on the optical disc 1.
[0090]

At a step S1, the PCI interface 3 stores the low resolution data, which is input from the low resolution encoder 17 so as to be recorded on the optical disc 1, in the buffer 31 while supplying the same low resolution data

5   to the disc drive 2. The disc drive 2 records the low resolution data supplied from the PCI interface 3 on the optical disc 1.
[0091]

At a step S2, the system controller 10 determines

10   whether there is excessive time before a~the start of writing next main track data or not. If it is determined that there is no excessive time before writing, that is, it is necessary to immediately write the next main track data, the verification process is terminated, expecting that the

15   low resolution is recorded on the optical disc 1 without any abnormality.
[0092]

On the other hand, if it is determined that there is excessive time before writing at the step S2, the process

20   proceeds to a step S3. At the step S3, the disc drive 2 reads out the low resolution data written on the optical disc 1 by the process at the step S1 so as to supply it to the comparison section 32 of the PCI interface 3. Then, at a step S4, the comparison section 32 reads out the low

25   resolution data stored in the buffer 31 and then compares the readout data with the low resolution data supplied from the disc drive 2 in the process at the step S3 so as to determine whether they are identical with each other or not. If it is determined that these data are identical with each

other, the verification process is terminated because it
means that the low resolution data is recorded on the
optical disc 1 without any abnormality.
[0093]

5   On the other hand, if it is determined that these data
are not identical with each other at the step S4, the
process proceeds to a step S5. At the step S5, the
comparison section 32 determines whether or not the low
resolution data has been determined as not being identical
10   with the same low resolution data read out from the buffer
31 for successive two or more times in the process at the
step S4. If it is determined that the low resolution data
has not been determined as not being identical for
successive two or more times, the process returns to the
15   step S1 so as to rewrite the same low resolution data on
the optical disc 1. Then, the subsequent processes are
repeated.
[0094]

       If it is determined that the low resolution data has
20   been determined as not being identical for successive two
or more times at the step S5, the process proceeds to a
step S6 because it is considered that a write error is
caused by, for example, the presence of an area on the
optical disc 1, on which data can be hardly recorded. At
25   the step S6, the disc drive 2 moves the pickup 2A in a
radial direction of the optical disc 1 so that subsequently
recorded data is recorded on a recording area separate from
the actual recording area on the optical disc 1.
Thereafter, the process returns to the step S1 followed by

the subsequent steps. The description of the procedure of
the verification process has been made above.
[0095]

By moving the pickup 2A as in the process at the step
5 S6 described above, the subsequent main track data can be
prevented from being written in the area that may be
present on the optical disc 1, on which data can be hardly
recorded. As a result, the reliability in writing ~~of~~ the
main track data can be improved.
10 [0096]

Fig. 5 shows a state where the above-described
verification process is executed in a case where a
recording rate of the disc drive 2 on the optical disc 1 is
not sufficiently high with respect to ~~a~~ the bit rate of the
15 data (the main track data, the low resolution data and the
like) to be recorded on the optical disc 1. In the
illustrated case, each of the low resolution data A and C
is successfully written at the first writing, whereas the
low resolution data B is written twice because the first
20 writing is failed. In this case, since it is necessary to
record the next main track data immediately after the
second writing of the low resolution data B, it is not
certain if the low resolution data B is correctly written
by the second writing.
25 [0097]

Fig. 6 shows a state where the above-described
verification process is executed in a case where ~~a~~ the
recording rate of the disc drive 2 on the optical disc 1 is
sufficiently high with respect to ~~a~~ the bit rate of the

data to be recorded on the optical disc 1. In the
illustrated case, the low resolution data B is successfully
written at the first writing, whereas the low resolution
data A is successfully written at the third writing after
5 the pickup 2A is moved because the first and second
writings of the low resolution data A are failed.
[0098]

Next, a process of playing back a recorded video
signal while encoding an input video signal so as to record
10 it on the optical disc 1 (hereinafter, referred to as a
time-shift playback process) will be described.
[0099]

As described above, the disc recording/reproducing
device constituting the embodiment of the present invention
15 encodes an input video signal at two types of resolution so
that the resulting high bit-rate main track data and low
bit-rate low resolution data are substantially
simultaneously recorded on the optical disc 1. A—The bit
rate of the carton containing the main track data and the
20 low resolution data is 30 Mbps.
[0100]

If a—the recording rate of the disc drive 2 is about
35 Mbps, an input video signal for two seconds is recorded
every two seconds. However, since the actual time required
25 to record the carton corresponding to the video signal for
two seconds is only 1.68 seconds, excessive 0.32 seconds
are generated every two seconds.
[0101]

In this case, as shown in Fig. 7, a plurality of tags,

each containing the low resolution data, are read out at a
time so as to play back the readout low resolution data
within excessive time generated by successively recording a
plurality of cartons in the time-shift playback process.

5   For example, five cartons corresponding to an input video
signal for 10 seconds are successively recorded. Five tags
are successively read out within the resulting excessive
time of 1.6 (= 5 × 0.32) seconds so as to play back the low
resolution data for 10 seconds of reproduction time.

10   [0102]

If a time difference between the time of the video
signal being recorded and the reproduction time of a time-
shift played back video signal (hereinafter, referred to as
trace time) is short, a—the recording position and a—the

15   readout position are close to each other. Therefore, there
arise—few problems arise because the amount of movement of
the pickup 2A for reading out the tag is small. In a case
where the trace time is long, however, the recording
position and the readout position are separate away from

20   each other. Therefore, a moving distance of the pickup 2A
for reading out the tag becomes long so that the movement
of the pickup 2A takes a longer time. Accordingly, if a
unit of 5 tags is read out at a time as shown in Fig. 7,
the trace time is limited to about 70 seconds so that the

25   time-shift playback is continuously performed without any
interruptions.

[0103]

Next, a case where a recording rate of the disc drive
2 is about 70 Mbps will be considered. Also in this case,

an input video signal for two seconds is recorded every two

seconds. However, since ~~an~~ the actual amount of time

required to record a carton corresponding to the video

signal for two seconds is only 0.84 seconds, an excessive

5   time of 1.16 seconds is generated every two seconds.

[0104]

In this case, the tag containing the low resolution

data is read out so as to play back the readout low

resolution data in the time-shift playback within the

10   excessive time of 1.16 seconds which is generated by

recording one carton, as shown in Fig. 8. In a case where

the excessive time is as long as 1.16 seconds as described

above, there will be no problem if the amount of movement

of the pickup 2A for reading out the tag becomes large.

15   Therefore, even without limiting the trace time, for

example, even if the trace time is set to be 100 seconds,

the time-shift playback can be continuously performed

without any interruptions.

[0105]

20   Moreover, in a case where the excessive time is as

long as 1.16 seconds as described above, only a small

amount of movement of the pickup 2A is required to read out

the tag if the trace time is short (for example, one

second). Thus, the main track data may be read out so as to

25   be played back instead of reading out the recorded tag. In

such a case, an image provided for a user by the time-shift

playback has high image quality.

[0106]

Although the tag is read out after completion of

recording in units of carton in the above description, the
tag may be read out in response to a direction of time-
shift playback given by a user even if the recording in
units of carton is in progress. In such a manner, the

5   quick-~~responsibility~~ responsiveness to a user's operation
can be enhanced.

[0107]

A pair of the pickups 2A may be provided for the disc
drive 2 so that both of them are enabled to read out data.

10   As a result, in a case where the recording rate of the disc
drive 2 is about 35 Mbps, it is no longer necessary to
limit the trace time. In a case where the recording rate
of the disc drive 2 is about 70 Mbps, the time-shift
playback using the main track data can be constantly

15   performed regardless of the trace time.

[0108]

Next, a process of recording input video data on the
optical disc 1 while externally transmitting the recorded
video data through, for example, a LAN (Local Area Network)

20   (hereinafter, this process is referred to as an upload
process) will be described.

[0109]

The upload process is in common with the above-
described time-shift playback process in that the low

25   resolution data is read out from the optical disc 1 within
the excessive time generated after each recording of the
carton containing the main track data and the low
resolution data on the optical disc 1. In the time-shift
playback process, however, the read_out low resolution data

is played back at single speed, that is, processed at a constant speed. On the other hand, in the upload process, the read out low resolution data is communicated through a predetermined network or the like. Therefore, unlike the

5   time-shift playback process, the amount of time required to transmit a fixed amount of low resolution data is not necessarily fixed, depending on the busyness or congestion of the network and the like.

[0110]

10   Fig. 9 shows an exemplary inner configuration of the PCI interface 3 for the upload process. The buffer 31 is used to temporarily store the low resolution data input from the low resolution encoder 17 so as to be recorded on the optical disc 1; and to store the low resolution data

15   read out from the optical disc 1 by the disc drive 2 so as be transmitted by the transmission section 18. In the upload process, if the low resolution data to be transmitted is present in the buffer 31 for recording, the low resolution data is read out so as to be transmitted.

20   On the other hand, if the low resolution data to be transmitted is not present in the buffer 31, the low resolution data to be transmitted is read out from the optical disc 1 so as to be stored in the buffer 31. Then, the low resolution data is read out from the buffer 31 so

25   as to be transmitted.

[0111]

Fig. 10 shows an example of the upload process, assuming that three low resolution data are successively read out from the optical disc 1 for each time.

[0112]

In the illustrated case, since the 0th to third low
resolution data to be transmitted are present in the buffer
31 at the time of transmission, these low resolution data

5   are not read out from the optical disc 1 whereas the low
resolution data present in the buffer 31 are transmitted.
However, since a—the transmission speed of these low
resolution data is low due to a—the status of the network
or the like, the fourth low resolution data is no longer

10 present in the buffer 31 when the fourth low resolution
data is to be transmitted whereas the eighth to tenth low
resolution data are stored therein. Accordingly, the
fourth to sixth low resolution data are read out from the
optical disc 1 to be stored in the buffer 31 for the

15 transmission.

[0113]

If a—the transmission speed of the fourth and all the
low resolution data that follow is improved, up to the
seventh low resolution data are read out from the optical

20 disc 1. For the eighth and all the low resolution data
that follow, however, the readout of these low resolution
data from the optical disc 1 is omitted because the low
resolution data stored in the buffer 31 for recording still
remain at the time of transmission. Therefore, the low

25 resolution data stored in the buffer 31 are used for
transmission.

[0114]

The upload process is realized by executing in
parallel a writing process of writing the low resolution

data on the optical disc 1 and a transmission process of
externally transmitting the low resolution data. First,
one of these processes, that is, the writing process will
be described with reference to a flowchart shown in Fig. 11.

5   [0115]

At a step S11, the PCI interface 3 sets an invalid
value -1 to a register reg[], which indicates a carton
number of data stored in the buffer 31 in the arrangement
of the same size as that of the buffer 31, so as to clear

10   the register. The PCI interface 3 sets a frequency limit
value mf0 to a counter mf for limiting a readout frequency.
Herein, the frequency limit value mf0 may be automatically
set in accordance with a communication speed as shown in
Fig. 15 or may be arbitrarily set by a user.

15   [0116]

Moreover, at the step S11, the PCI interface 3 sets kr
indicating a carton number of the last written data to +∞
and kw indicating the last readout data to 0.
[0117]

20   At a step S12, the PCI interface 31 waits until data
for one carton is stored in the buffer 31. After the data
for one carton is stored in the buffer 31, the process
proceeds to a step S13. At the step S13, the PCI interface
3 outputs the data for one carton stored in the buffer 31

25   to the disc drive 2. The disc drive 2 records the input
data for one carton to the optical disc 1.
[0118]

At a step S14, the PCI interface 3 determines whether
the data for one carton which is stored in the buffer 31 is

used shortly or not. If it is determined that the data is
used shortly, the data for one carton is not erased but
kept in the buffer 31. The process at the step S14 will be
described with reference to a flowchart shown in Fig. 12.

5 [0119]

At a step 21, it is determined whether data, which is
different from that previously written on the optical disc
1 and being still stored in the buffer 31, is read out or
not. If it is determined that the different data is read

10 out, the data stored in the buffer 31 is abandoned. Then,
the process returns to a step S15 in Fig. 11.

[0120]

If it is determined that the data different from the
data stored in the buffer 31 is not read out at the step

15 S21, the process proceeds to a step S22. At the step S22,
it is determined whether the data still stored in the
buffer 31 is read out or not. If it is determined that the
data is read out, the process proceeds to a step S23. At
the step S23, it is determined whether a conditional

20 expression: kt < kw < kt + 10 is satisfied or not. If it
is determined that the conditional expression is satisfied,
the process returns to the step S15 in Fig. 11. In this
conditional expression, kt is a the carton number of the
data being transmitted.

25 [0121]

If it is determined that the conditional expression:
kt < kw < kt + 10 is not satisfied at the step S23, the
process proceeds to a step S24. At the step S24, the data
still stored in the buffer 31 is further kept in the buffer

31, and kw is set to the register reg [kw%10]. The process
returns to the step S15 in Fig. 11.

[0122]

At the step S15 in Fig. 11, the PCI interface 3

5   increments the count mf by 1. At a subsequent step S16,
the PCI interface 3 determines whether the buffer 31 is
void or not. After the determination, the process proceeds
to a step S17. At the step S17, the data is duly read out
from the optical disc 1. A process at the step S17 is

10 described with reference to a flowchart shown in Fig. 13.

[0123]

At a step S31, it is determined whether all
conditional expressions: kr - kt < kr0, kt > kw - dt0, and
mf > mf0 are satisfied or not. In these conditional

15 expressions, kr0 is a value of ~~an~~ the exhaustion limit of
the buffer 31. This value may be automatically set in
accordance with a communication speed or may be arbitrarily
set by a user. Moreover, dt0 is a set value of the trace
time.

20 [0124]

If it is determined that at least one of the
conditional expressions is not satisfied, the process
returns to a step S18 in Fig. 11. On the other hand, if it
is determined that all the conditional expressions are

25 satisfied, the process proceeds to a step S32. At the step
S32, it is determined whether an image reproduction mode is
set (pb = ture) or not and whether the trace time is equal
to or lower than the limit value dt0 or not.

[0125]

At a step S33, if it is determined that a desired carton is not yet written (that is, data to be read out is not yet recorded) or there is data being used or unused, the process returns to the step S18 in Fig. 11. On the

5   other hand, if it is determined that the desired carton is not unwritten and there is no data being used or unused, the process proceeds to a step S34.

[0126]

At the step S34, it is determined whether the data to

10   be read out from the optical disc 1 is stored in the buffer 31 or not. If it is determined that the data is stored in the buffer 31, the following processes at steps S35 and S36 are skipped. If it is determined that the data is not stored in the buffer 31, the process proceeds to the step

15   S35. At the step S35, data for one carton is read out. However, if f = 0 is established, only the tag is read out. At the step S36, the counter mf is reset to 0. At a step S37, the register reg [k%10] is reset to kr (= K). The counter mf is reset to 0.

20   [0127]

If the number of times repeating the steps S33 to S38 is smaller than cr0 at a step S38, the process returns to the step S33 so as to repeat the subsequent processes. If the number of times repeating the steps S33 to S38 reaches

25   cr0, the process returns to the step S18 in Fig. 11.

[0128]

At a step S18 in Fig. 11, the PCI interface 3 determines whether the data for one carton is stored in the buffer 31 or not. If it is determined that the data for

one carton is not stored therein, the process returns to
the step S13 so as to repeat the subsequent processes. If
it is determined that the data for one carton is stored
therein at the step S18, the process proceeds to a step S19
5   where the verification process is executed if there is any
excessive time. Thereafter, the process returns to the
step S12 so as to repeat the subsequent processes. The
writing process, which corresponds to one of the processes
for realizing the upload process, has been described above.
10 [0129]

The transmission process, which corresponds to the
other one of the processes for realizing the upload process,
will now be described with reference to a flowchart shown
in Fig. 14. At a step S41, the PCI interface 3 sets kt
15 indicating a the carton number of the low resolution data
being transmitted to target -1 while setting the last
readout carton number kr to kt. At a step S42, the PCI
interface 3 determines that two conditions, that is, data
is being written and the same data is being read out, are
20 satisfied or not. If it is determined that any one of the
conditions is not satisfied, the process proceeds to a step
S43 where the register reg [] is all cleared (an invalid
value -1 is set). If it is determined that both of the
conditions are satisfied, the process proceeds to a step
25 S44 where the register reg [] is refreshed (if a value
other than kt + 1 to kt + 10 is set, the set value is
replaced by 0).
[0130]

At a step S45, the PCI interface 3 waits until a

conditional expression: kt < kr is satisfied. If it is
determined that the conditional expression is satisfied,
the process proceeds to a step S46. At the step S46, the
PCI interface 3 increments kt by 1. At a step S47, the PCI

5   interface 3 supplies the low resolution data having the
current number of kt to the transmission section 18. The
transmission section 18 transmits the supplied low
resolution data having the current number of kt.
Thereafter, the process returns to the step S45 so as to

10   repeat the subsequent processes. The transmission process,
which corresponds to the other one of the processes for
realizing the upload process, has been described.
[0131]

Next, a process in high-speed playback (so-called

15   shuttle playback) of playing back data at a higher speed
than a normal reproduction speed (single speed) will be
described with reference to Figs. 16 to 21.
[0132]

Fig. 16 shows high-speed playback performed by a

20   conventional DVD player or the like. In the conventional
case, it is common to instantaneously increase reproduction
speed from single speed to display images while skipping
some images in a similar way to show picture cards in the
high-speed play back; that is, in the high-speed playback,

25   a set of the number of images corresponding to the
reproduction speed are extracted so as to be displayed as
stationary images for each certain period of time, in the
high-speed playback.
[0133]

On the other hand, in the disc recording/reproducing
device according to this embodiment, the main track data is
played back in normal playback, whereas the low resolution
data is played back in high-speed playback. Instead of
5   instantaneously changing the reproduction speed in the
high-speed playback, the reproduction speed is gradually
changed at a constant acceleration as shown in Fig. 17.
The accelerated reproduction speed is calculated in a
predetermined period. In a state where the reproduction
10   speed is n-x speed, a screen is horizontally divided into n.
The areas obtained by the division are made to partially
display different frames of the low resolution data,
respectively, so as to allow a user to intuitively know the
current reproduction speed.

15   [0134]

The high-speed playback will be more specifically
described. If high-speed playback (for example, 8-x speed
playback (8-x speed reproduction)) is directed in a state
of normal playback where the main track data is displayed
20   on a screen, the reproduction speed gradually changes from
single speed to 8-x speed. When the reproduction speed
reaches double speed, for example, the screen is
horizontally divided in two. Two different frames of the
low resolution data are partially displayed in the
25   respective two areas obtained by the division. Similarly,
for example, when the reproduction speed reaches triple
speed, the screen is horizontally divided in three. Three
different frames of the low resolution data partially are
displayed partially in the respective three areas obtained

41

by the division. When the reproduction speed ultimately
reaches 8-x speed, the screen is horizontally divided into
eight. Eight different frames of the low resolution data
are partially displayed in the respective eight areas
5   obtained by the division.

[0135]

If normal playback is directed by a user while the
high-speed playback is in progress, the reproduction speed
of the high-speed playback using the low resolution data is
10   gradually lowered to single speed at a constant
acceleration in the reverse manner to that described above,
thereby switching the reproduction mode to single-speed
playback of the main track data. For example, Fig. 18
shows a state where a reproduction mode returns from 8-x
15   high-speed playback to normal playback.

[0136]

In 8-x high-speed playback, the screen is horizontally
divided into 8. Eight different frames of the low
resolution data are partially displayed in the respective
20   eight areas obtained by the division. If normal playback
is directed by a user in this state, the reproduction speed
is gradually lowered at a constant deceleration,
corresponding to the acceleration, to 7-x speed, 6-x speed,
5-x speed, 4-x speed, triple speed, double speed and single
25   speed. Meanwhile, for example, when the reproduction speed
is lowered to 5-x speed, the screen is horizontally divided
into 5. Five different five frames of the low resolution
data are partially displayed in the respective areas
obtained by the division. Similarly, when the reproduction

speed is lowered to double speed, the screen is horizontally divided into two, two different frames of the low resolution data are partially displayed in the respective two areas obtained by the division.

5   [0137]

In a case where the reproduction speed being accelerated is calculated in a predetermined period in the high-speed playback, the calculated reproduction speed being accelerated sometimes includes a decimal fraction,

10   depending on the predetermined period or a value of the acceleration. In such a case, the division of the display screen will be more complicated. Such a case will be described with reference to Fig. 19.

[0138]

15   For example, Fig. 19 shows an example where high-speed playback at 4-x speed is performed where a period for calculating the reproduction speed being accelerated is set to a time period allowing a frame to be switched in normal playback (in a case of NTSC, 1/30 seconds), a reproduction

20   speed v is 1 at timing t = 0, and an acceleration of the reproduction speed is 0.4 frames for each of the periods.

[0139]

In this case, at the timing t = 0, 1, 2, 3,...,8, the reproduction speed v is calculated as 1, 1.4, 1.8, 2.2, ...,

25   4.2.

[0140]

At the timing t = 0, the 0th frame is displayed on the screen.

[0141]

43

At the timing t = 1, a part of the first frame is displayed in an area having a height of 0.714 (= 1/1.4) obtained by division, where the total height of the screen is 1. In an area therebelow, a part of the second frame is

5   displayed.

[0142]

At the timing t = 2, a part of the third frame is displayed in an area having a height of 0.556 (= 1/1.8) obtained by division, where the total height of the screen

10   is 1. A part of the second frame is displayed in an area thereabove having a height obtained by: 0.6 × the height 0.556, where 0.6 corresponds to a fraction of the moving distance 1 = 2.4 with respect to 3, whereas a part of the fourth frame is displayed in an area therebelow.

15   [0143]

At the timing t = 3, a part of the fifth frame is displayed in an area having a height of 0.455 (= 1 /2.2) obtained by division, where the total height of the screen is 1. A part of the fourth frame is displayed in an area

20   thereabove having a height obtained by 0.8 × the height 0.455, where 0.8 corresponds to a fraction of the moving distance 1 = 4.2 with respect to 5, whereas a part of the sixth frame is displayed in an area therebelow.

[0144]

25   At the timing t = 4, a part of the seventh frame is displayed in an area having a height of 0.385 (= 1 /2.6) obtained by division, where the total height of the screen is 1. A part of the sixth frame is displayed in an area thereabove having a height obtained by 0.6 × the height

44

0.385, where 0.6 corresponds to a fraction of the moving distance l = 6.4 with respect to 7, whereas a part of the eighth frame is displayed in an area therebelow.

[0145]

5 For the following timings, the screen display is performed in a similar manner in accordance with the reproduction speed being accelerated.

[0146]

At the timing t = 8, the reproduction speed reaches a
10 target speed. At this time, an odd display area is generated by the division of the screen as shown in Fig. 20 on the left. If the high-speed playback is continued while such an odd display area is being present, the appearance is degraded. In addition, the process for display becomes
15 troublesome. Therefore, as shown on the right in Fig. 20 ~~on the right~~, the division of the screen is adjusted so as not to generate any odd areas. In the illustrated case, the screen is horizontally divided into four for display.

[0147]

20 On the contrary, in a case where the reproduction speed is lowered to single speed, for example, in response to a direction of normal playback by a user, from a state where the division of the screen is adjusted so as not to generate any odd areas as shown on the right in Fig. 20 ~~on~~
25 ~~the right~~, the adjustment is cancelled at the start of deceleration, as shown in Fig. 21. In this manner, the appearance can be prevented from being degraded as compared with a case where the adjustment is not cancelled at the start of deceleration but the adjustment is performed again

for an odd area, which is generated by the division of the screen when the reproduction speed returns to single speed.

[0148]

The above-described procedure of the high-speed
5   playback is summarized as shown in a flowchart of Fig. 22. At a step S51, the system controller 10 sets a target speed (for example, 4-x speed) in the high-speed playback in response to the manipulation of the remote commander 21 by a user. Then, the system controller 10 starts counting
10   time after initializing the timing t shown in Fig. 19 to 0 while initializing various parameters v, l and the like.

[0149]

At a step S52, the system controller 10 calculates various parameters (a reproduction speed v, a moving
15   distance l, a height of an area obtained by horizontally dividing a screen, and the like) corresponding to the timing t. The system controller 10 outputs the height of the area obtained by horizontally dividing the screen to the OSD section 8 so as to direct the generation of the
20   screen for the high-speed playback. At a step S53, in response to the direction from the system controller 10, the OSD section 8 generates video data whose different frames are partially displayed in the areas obtained by horizontally dividing the screen in accordance with the
25   reproduction speed, and then outputs the video data to the later stage.

[0150]

At a step S54, the system controller 10 determines whether the reproduction speed v calculated in the process

at the step S52 has reached the target speed set in the process at the step S51 or not. If it is determined that the calculated reproduction speed v has not reached the target speed, the process returns to the step S51 so as to

5   repeat the subsequent processes.

[0151]

Then, at the step S54, if it is determined that the reproduction speed v calculated in the process at the step S52 has reached the target speed set in the process at the

10 step S51, the process proceeds to a step S55. At the step S55, in response to the direction from the system controller 10, the OSD section 8 adjusts an odd area present in the video data generated by the process at the step S53 so as to output the video data to the later stage.

15 [0152]

Thereafter, the process returns to the step S53 so as to repeat the subsequent processes until the termination of the high-speed playback is directed. The high-speed playback process has been described above.

20 [0153]

Although the reproduction of video data has been described in the above embodiment, the present invention is also applicable to, for example, reproduction of audio data.

[0154]

25 Although the low resolution data obtained by degrading the resolution of the main track data is used as the low resolution data in the above embodiment, it is also possible to use low resolution data obtained by, for example, reducing the number of bits allocated to pixels

constituting the main track data as the low resolution data.
[0155]

Furthermore, although the JPEG system is used as the encoding method for the low resolution data in the above

5 embodiment, the encoding method used for the low resolution data is not limited to the JPEG method.
[0156]

Although the MPEG system is used as the encode method for the main track data in the above embodiment, the

10 encoding method for the main track data is not limited to the MPEG system.
[0157]

Although the encoded video data are used for both the low resolution data and the main track data in the above

15 embodiment, the video data without being encoded can be used as the low resolution data and the main track data.
[0158]

Although the length of the carton is set to about 2 seconds in the above embodiment, the length of the carton

20 is not limited thereto. For example, by reducing the length of the carton, a track jump from the low resolution data to the main track data can be reduced or omitted so as to further improve the response. On the other hand, by increasing the length of the carton, it becomes easy to

25 read out the low resolution data in advance for storage. In this case, since it is not necessary to read out the low resolution data at each start of reproduction, the response can be further improved.
[0159]

A series of the above-described processes may be executed either by a hardware or by a software. In a case where the series of the processes are executed by a software, the software is installed from a recording medium

5 to a computer, in which a program constituting the software is incorporated into a dedicated hardware, or, for example, to a general-propose personal computer capable of executing various functions by installation of various programs.

[0160]

10 Throughout the specification, the steps describing the program recorded on a recording medium include not only the processes performed in time series in accordance with the described order but also the processes executed in parallel or individually without being necessarily processed in time

15 series.

[0161]

Throughout the specification, the system means the entire device configured with a plurality of devices.